Relationships between *meteorological regime* and *convective precipitation characteristics* near Darwin, Australia

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Motivating Questions

- How do the TWP-ICE cloud and precipitation systems compare….active monsoon *vs.* dry monsoon *vs.* break period? How about convective intensity?
- How representative of long-term climatology are the cloud and precipitation systems observed during TWP-ICE? Larger or smaller? Stronger or weaker?
- Can (*should*) we represent the thermodynamic conditions by a single sounding during active monsoon, dry monsoon, and break periods? What is diurnal cycle during TWP-ICE?

Some detailed issues to resolve

- Can we compare the C-POL radar data during TWP-ICE to the 10-year TRMM Precipitation Feature (PF) database without bias?
- How well does a single sounding represent the diurnal cycle *vs*. observations? Is it OK during the active monsoon, even if it isn't during break conditions?
- Can we objectively partition thermodynamic and wind conditions at Darwin into regimes, that are well-related to convective properties? *(for AGU)*

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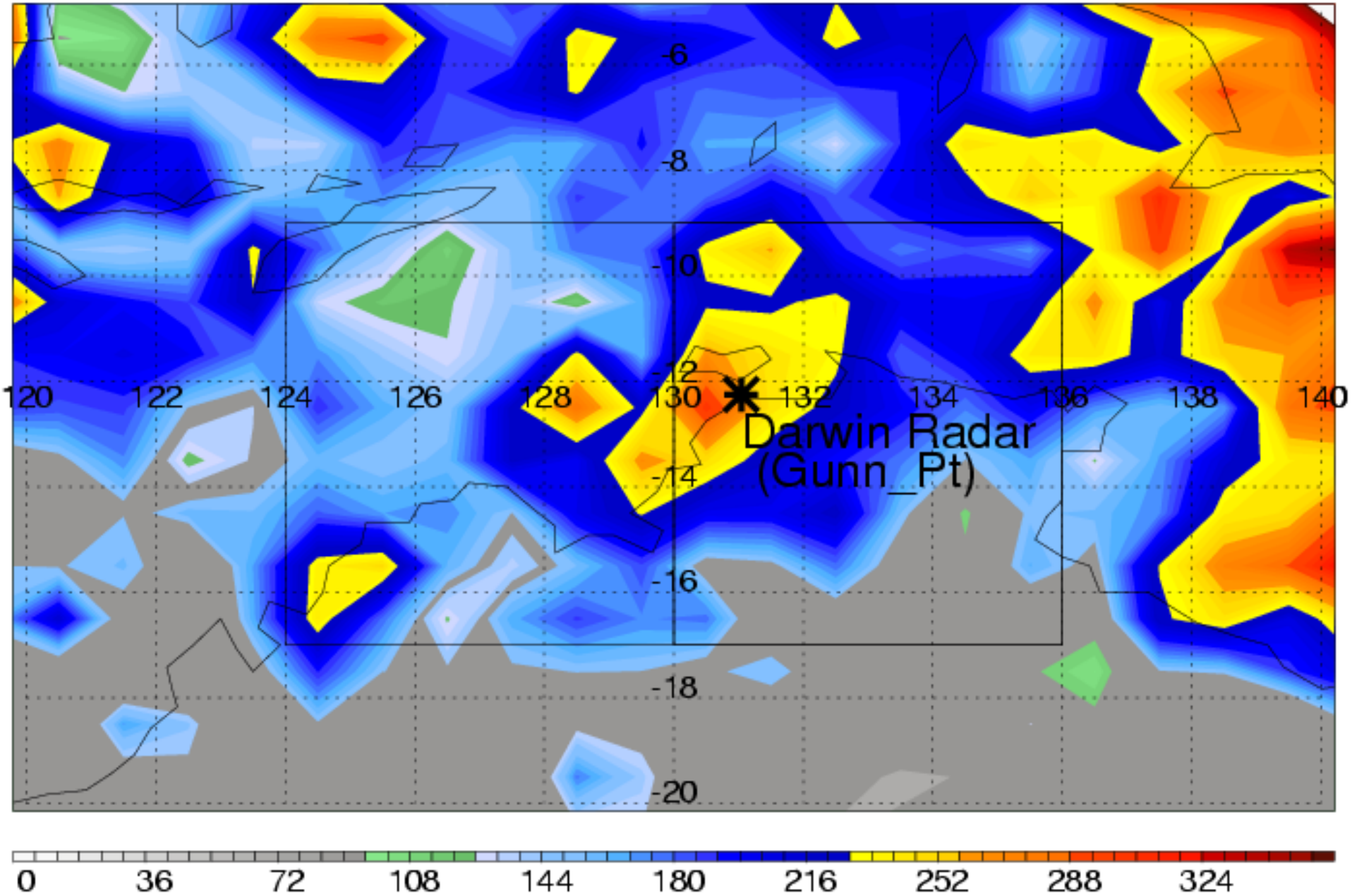
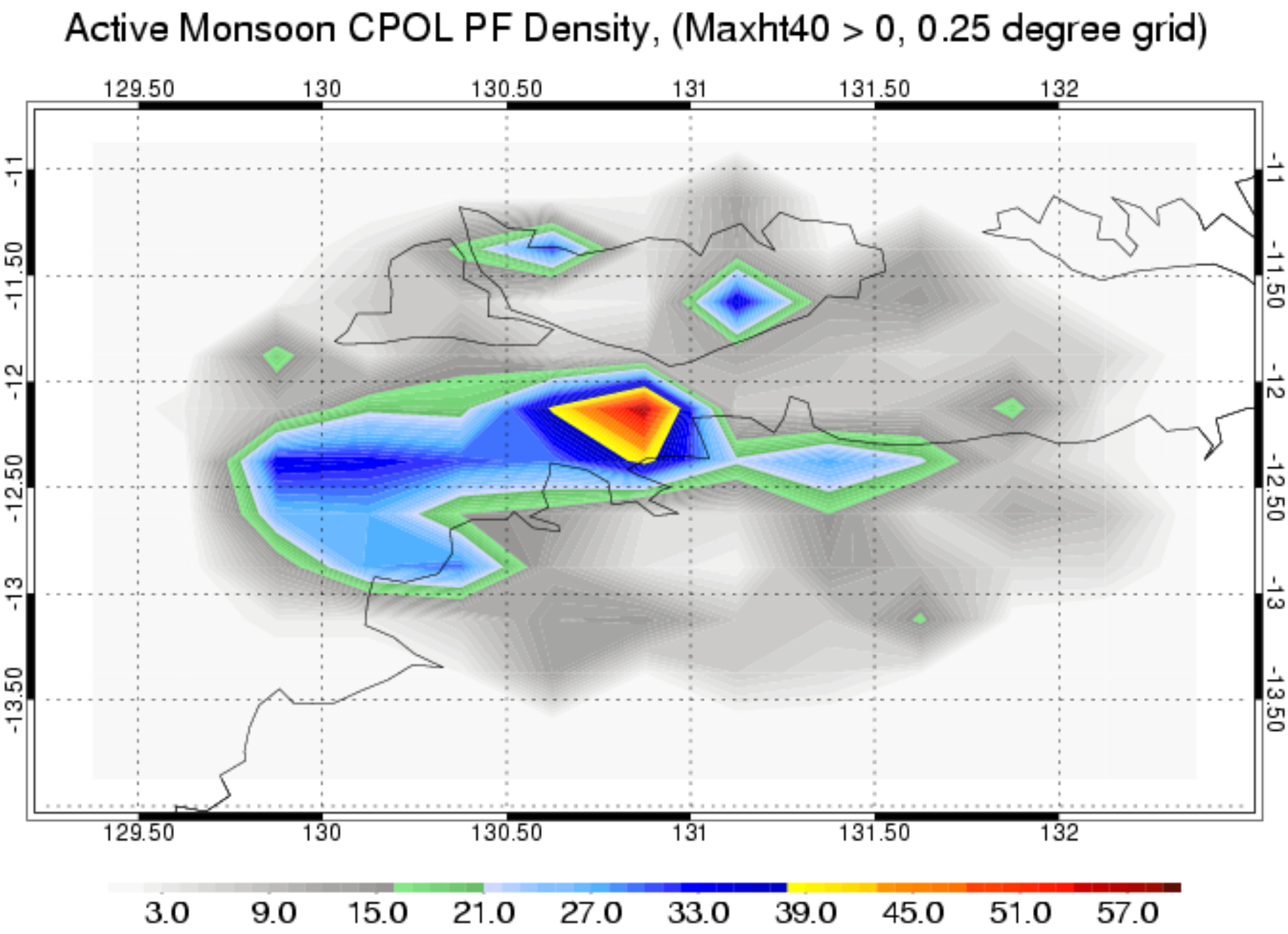
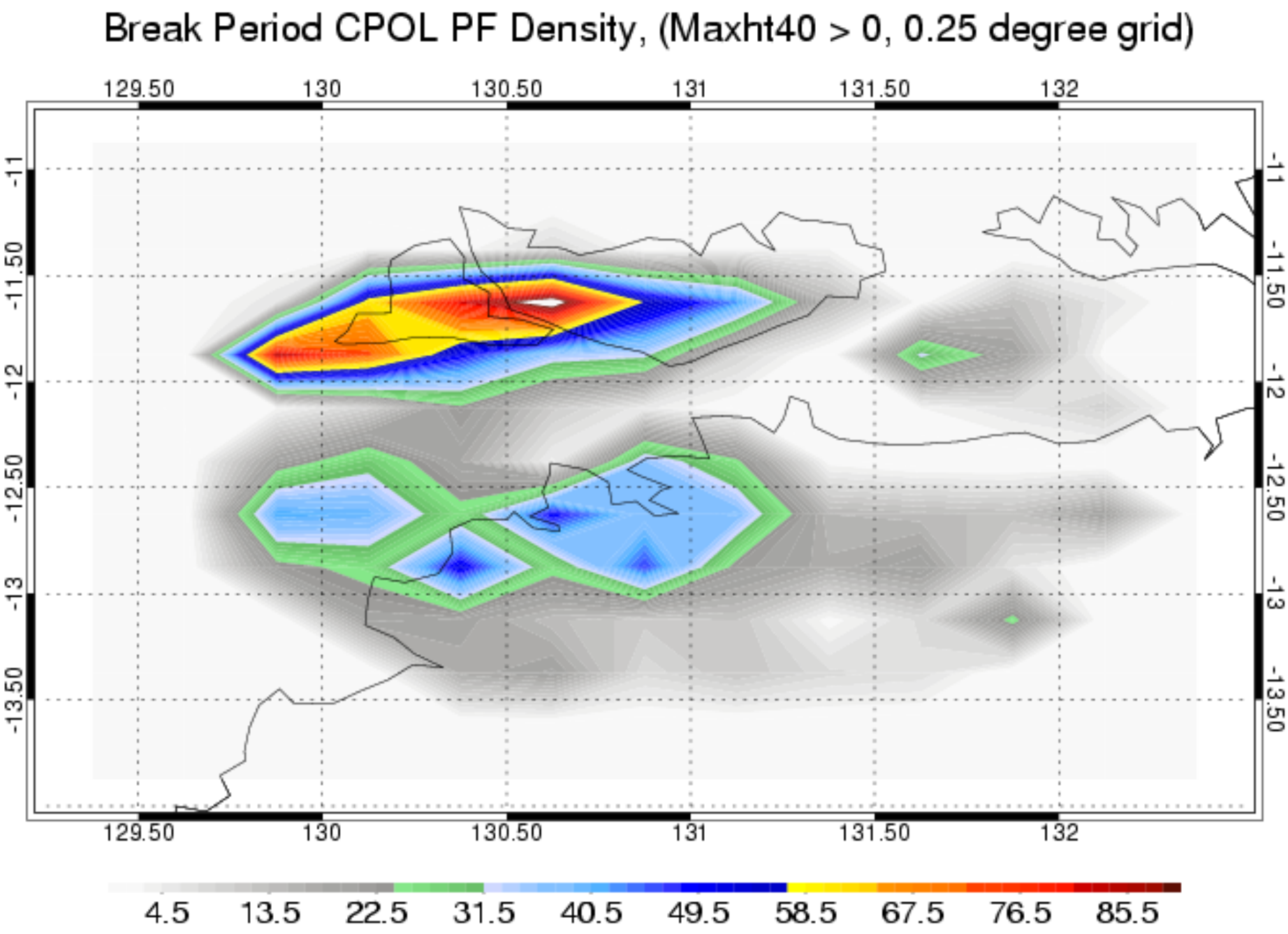
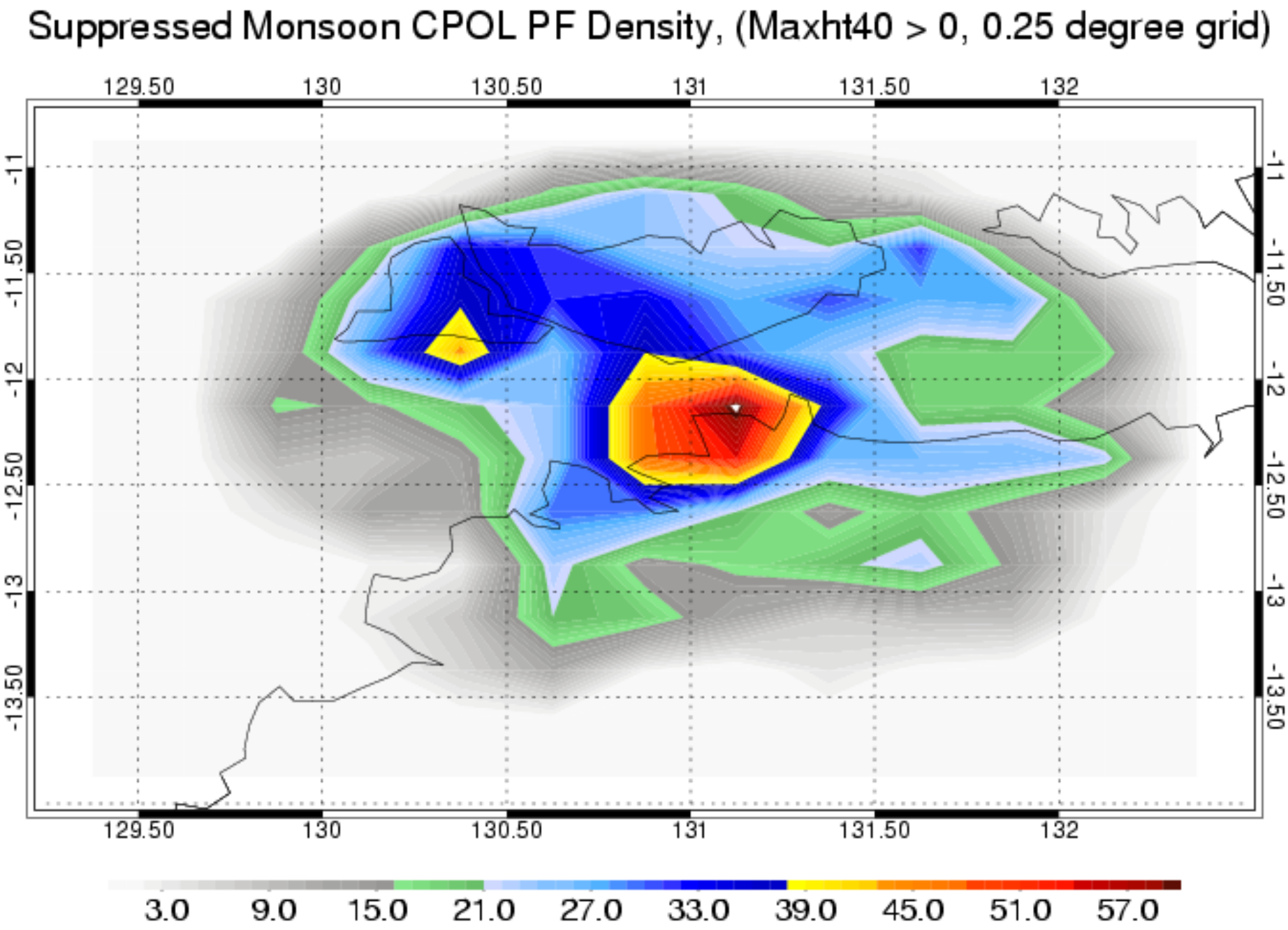
TRMM 3A25 DJF rainfall (mm/month) (*9 years TRMM radar data*)




Active Monsoon CPOL PF Density, (Maxht40 > 0, 0.25 degree grid)
129.50
130
130.50
131
131.50
132
-11
-11.50
-12
-12.50
-13
-13.50
3.0
9.0
15.0
21.0
27.0
33.0
39.0
45.0
51.0
57.0

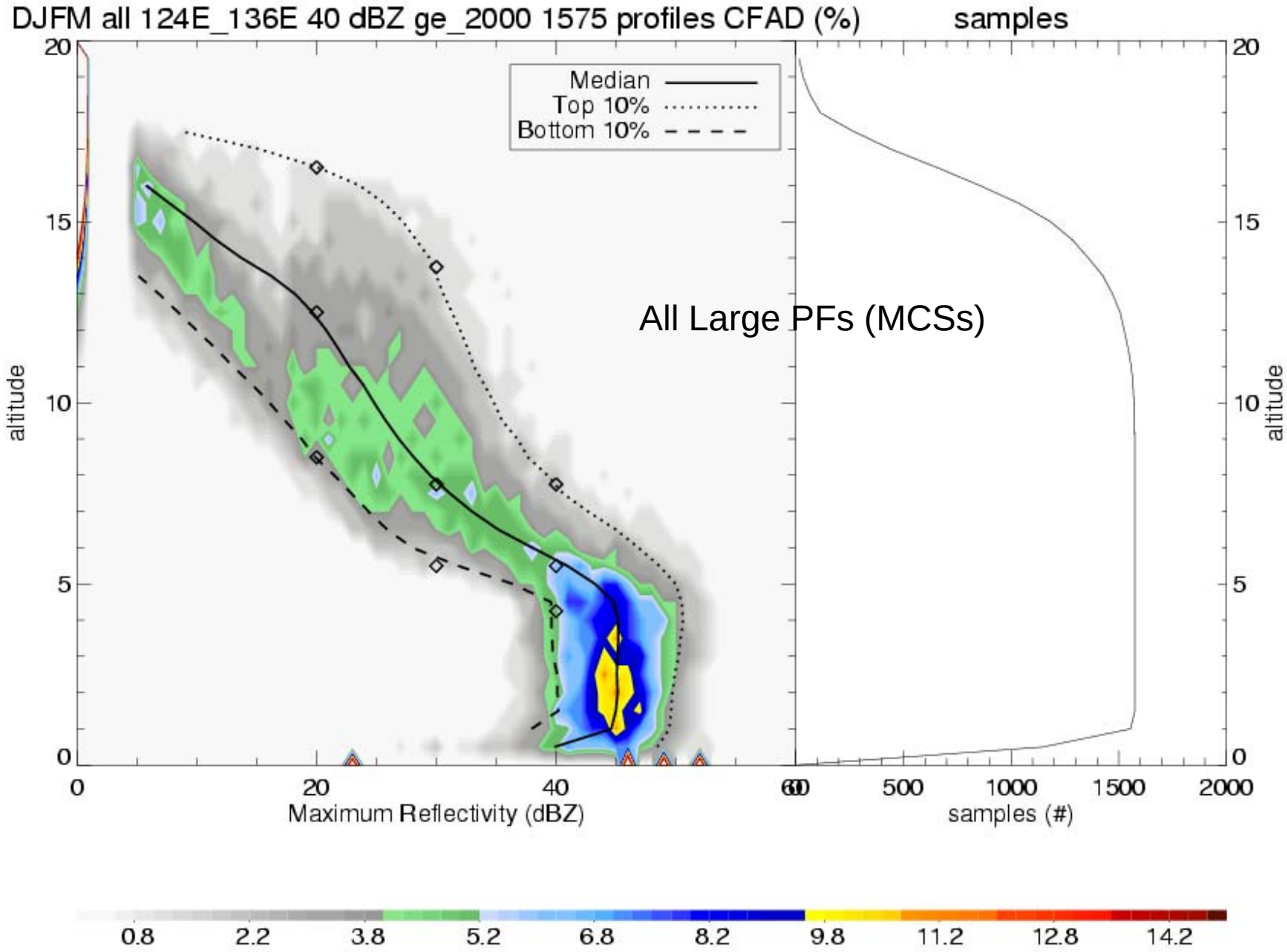

Break Period CPOL PF Density, (Maxht40 > 0, 0.25 degree grid)
129.50
130
130.50
131
131.50
132
-11
-11.50
-12
-12.50
-13
-13.50
4.5
13.5
22.5
31.5
40.5
49.5
58.5
67.5
76.5
85.5

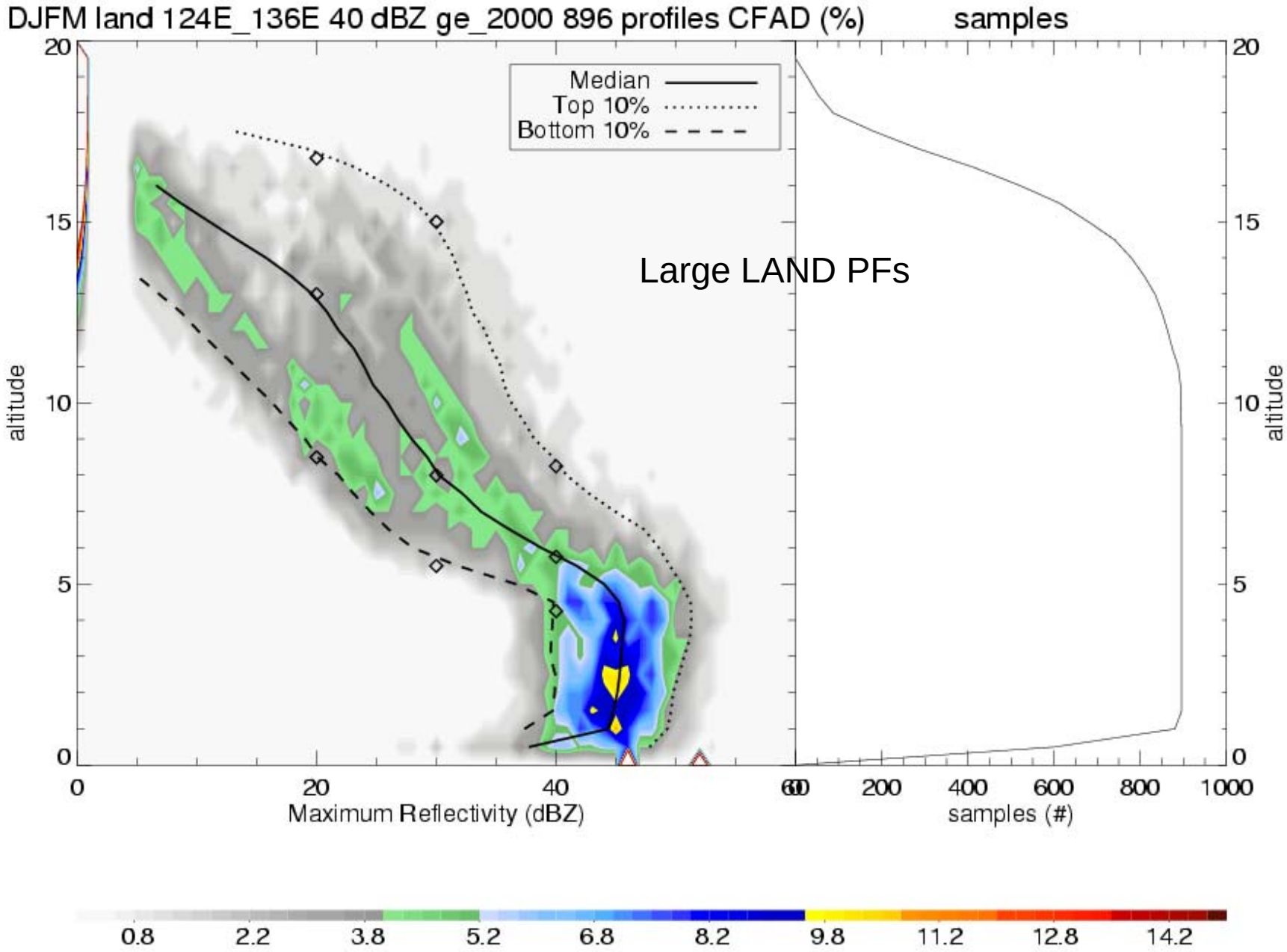

Suppressed Monsoon CPOL PF Density, (Maxht40 > 0, 0.25 degree grid)
129.50
130
130.50
131
131.50
132
-11
-11.50
-12
-12.50
-13
-13.50
3.0
9.0
15.0
21.0
27.0
33.0
39.0
45.0
51.0
57.0

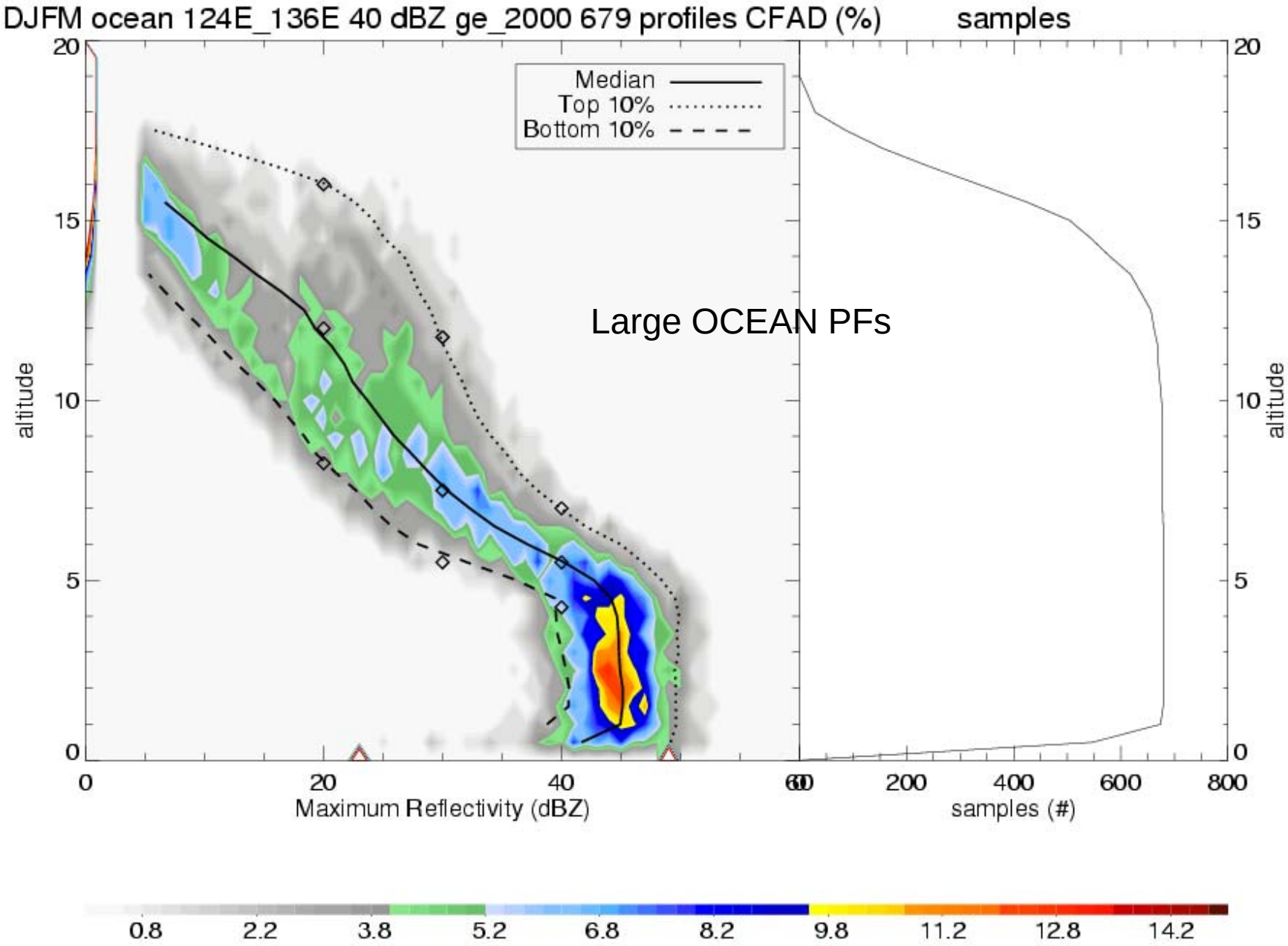
“Convective Climatology” for Darwin area

- 12° (long) X 8° (lat) area centered on Darwin
- Dec-Jan-Feb-March for 9 years of TRMM data
- Define TRMM radar Precipitation Features (PF) by size, by land vs. ocean, and by U @ 700 hPa
- Compare Contoured Frequency by Altitude Diagrams (CFADs; Yuter and Houze 1995)

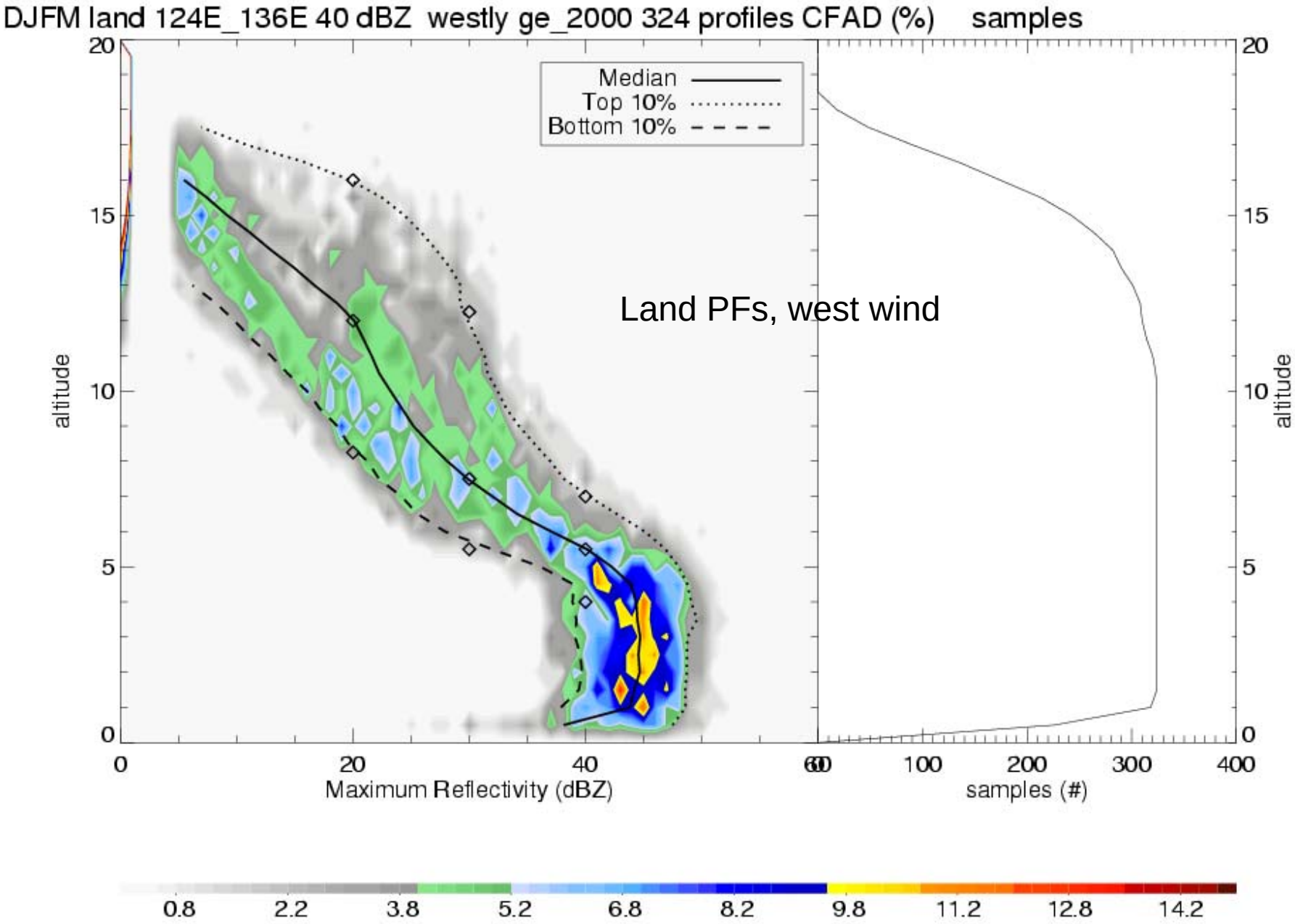
FIRST: Mesoscale systems, land vs. ocean


DJFM all 124E_136E 40 dBZ ge_2000 1575 profiles CFAD (%)
samples
Median
Top 10%
Bottom 10%
All Large PFs (MCSs)
altitude
Maximum Reflectivity (dBZ)
samples (#)
0
20
40
60
500
1000
1500
2000
5
10
15
20
0.8
2.2
3.8
5.2
6.8
8.2
9.8
11.2
12.8
14.2

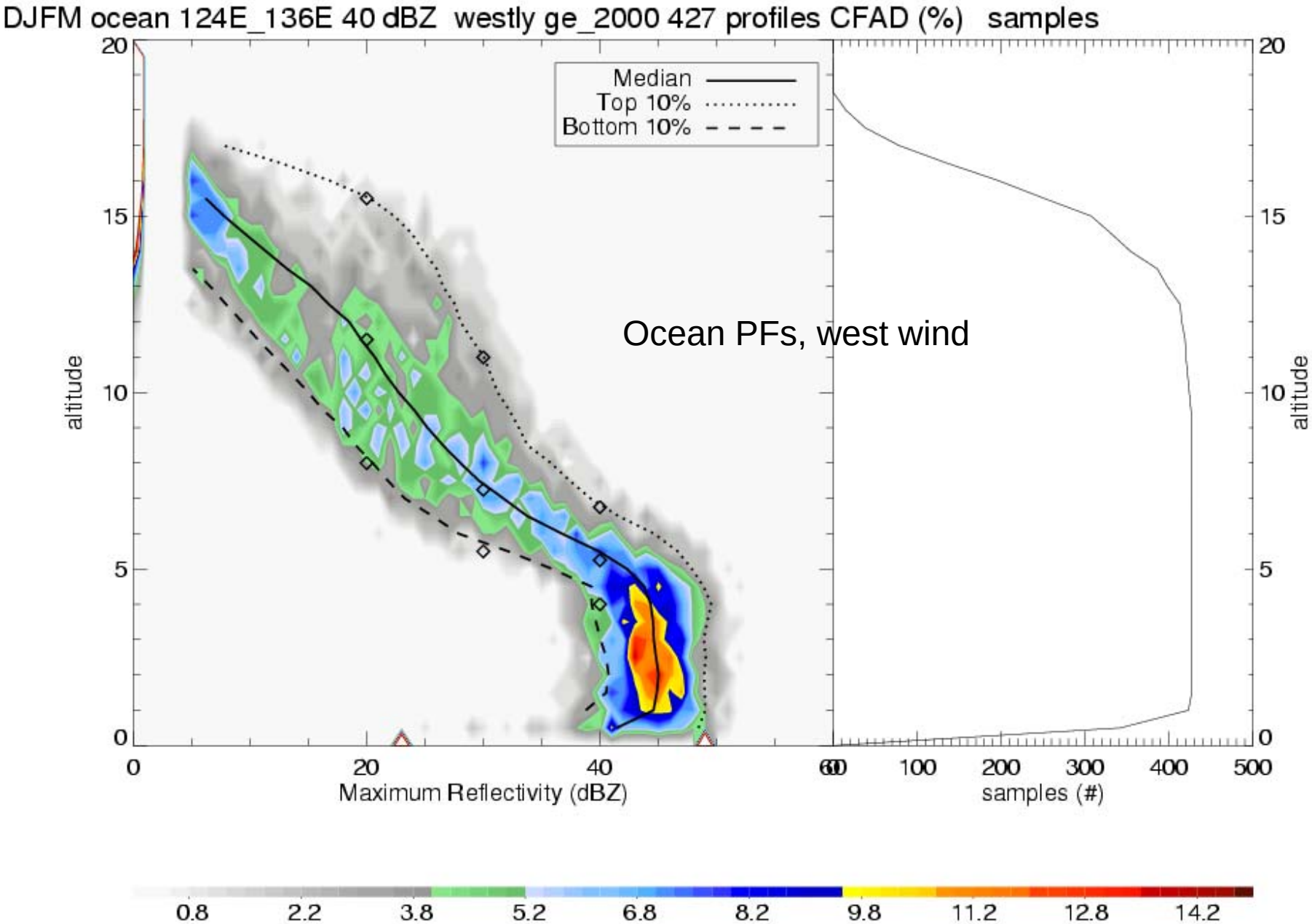

DJFM land 124E_136E 40 dBZ ge_2000 896 profiles CFAD (%)
samples
Median
Top 10%
Bottom 10%
Large LAND PFs
altitude
Maximum Reflectivity (dBZ)
samples (#)
0
5
10
15
20
0
20
40
60
200
400
600
800
1000
0.8
2.2
3.8
5.2
6.8
8.2
9.8
11.2
12.8
14.2


DJFM ocean 124E_136E 40 dBZ ge_2000 679 profiles CFAD (%)
samples
Median
Top 10%
Bottom 10%
Large OCEAN PFs
altitude
Maximum Reflectivity (dBZ)
samples (#)
0
5
10
15
20
0
20
40
60
200
400
600
800
0.8
2.2
3.8
5.2
6.8
8.2
9.8
11.2
12.8
14.2

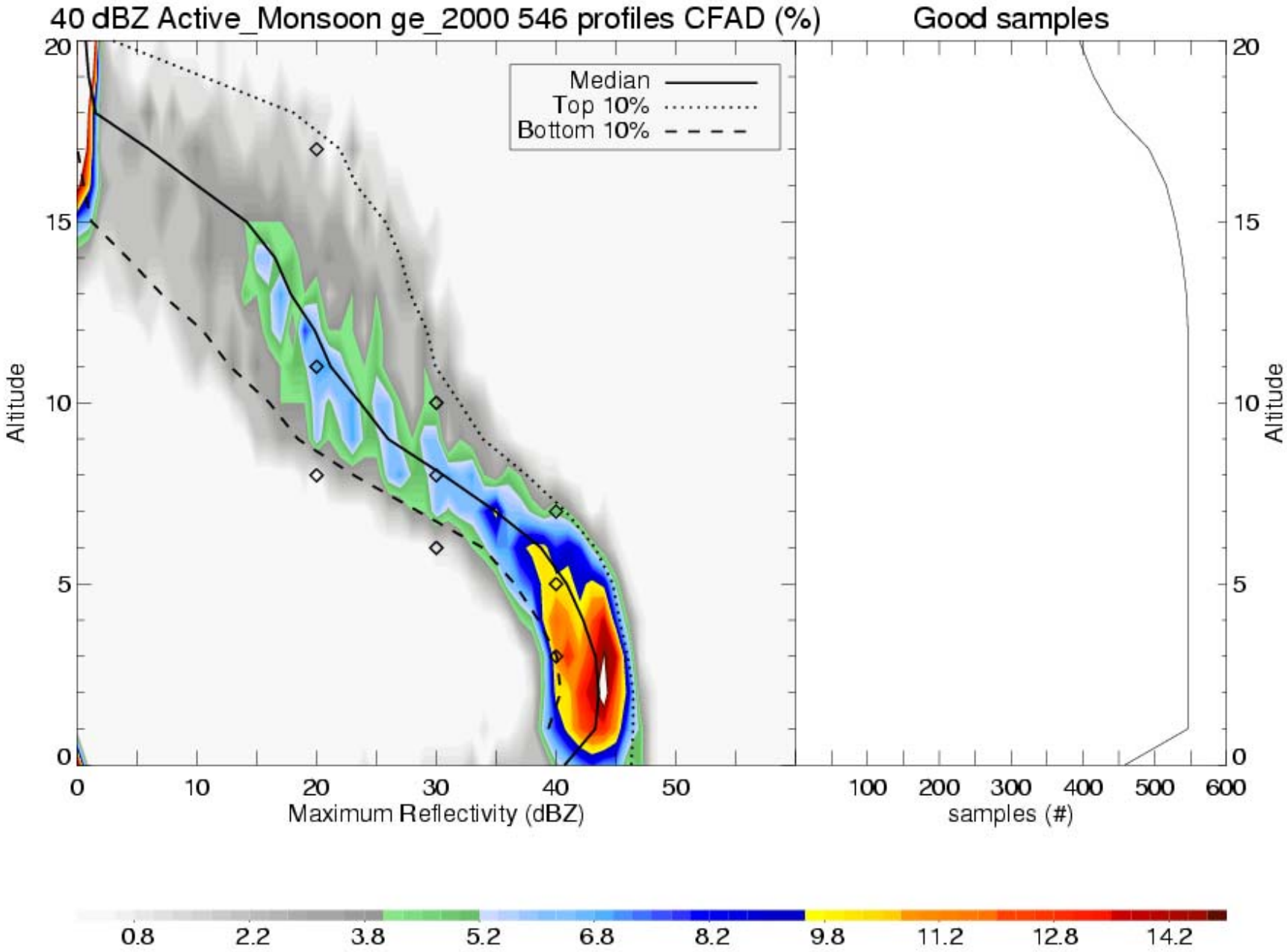
TRMM, 9 years, MCSs during “monsoon”, land



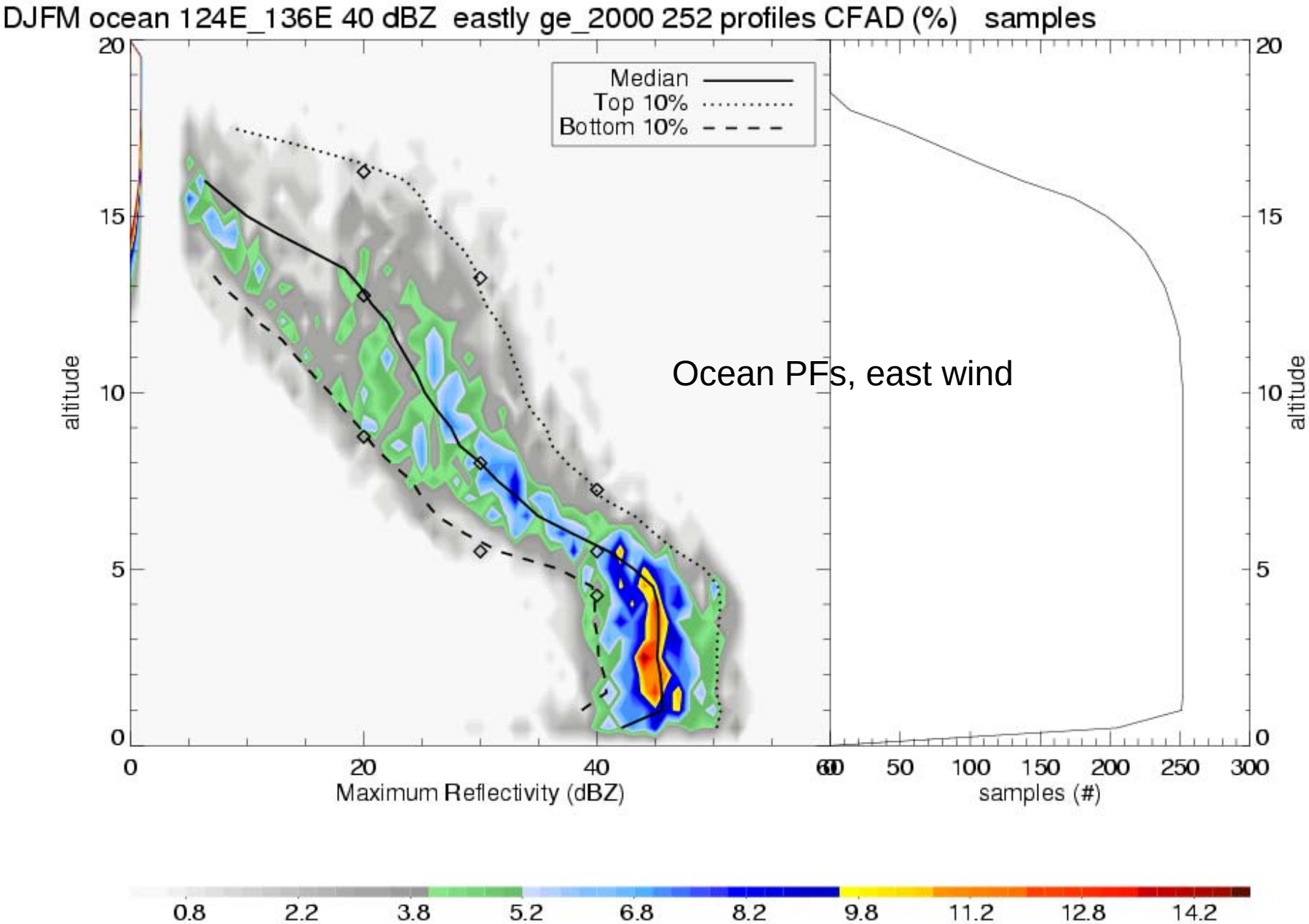
TRMM, 9 years, MCSs during “monsoon”, ocean



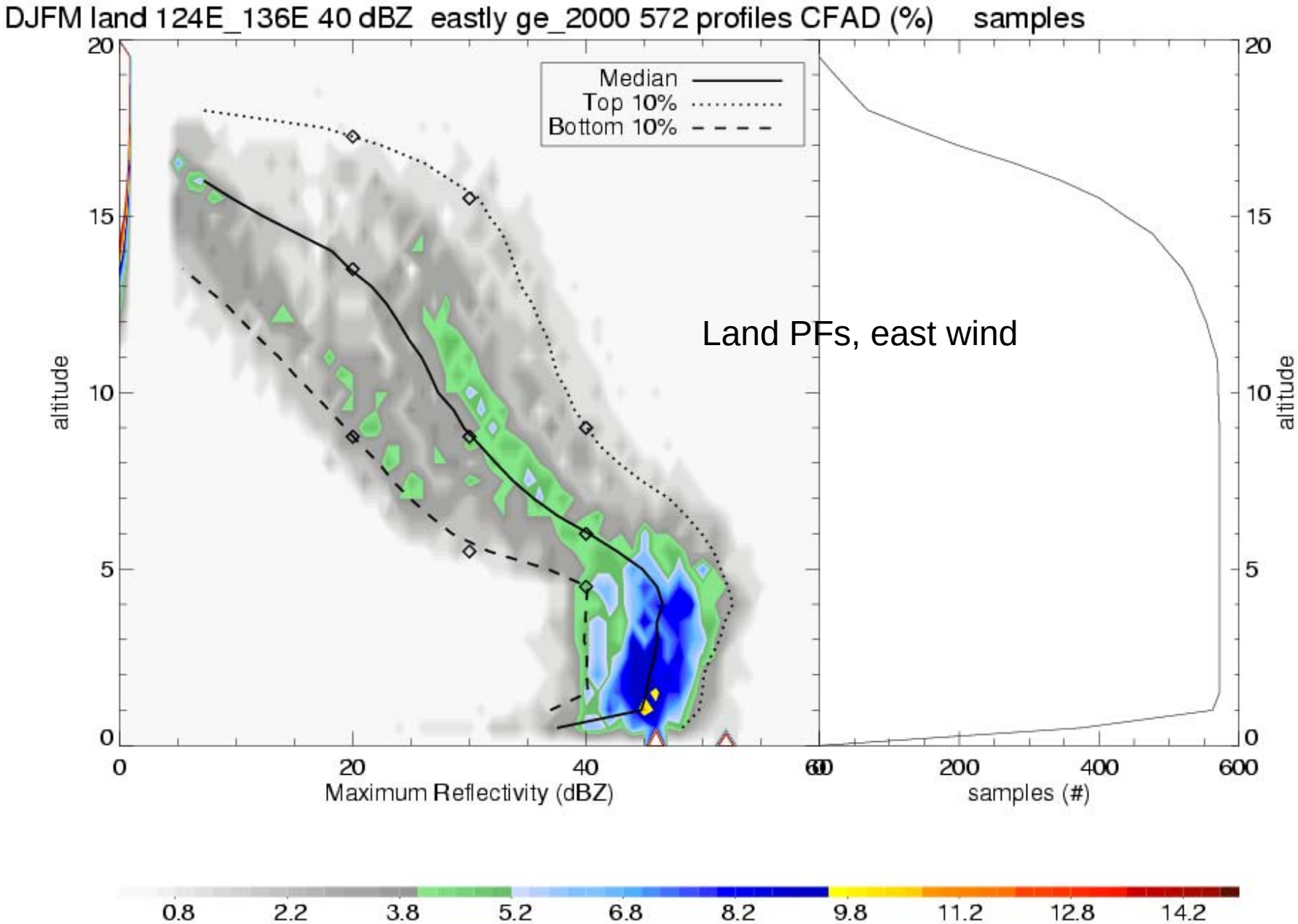
C-POL during TWP-ICE, Active Monsoon, MCSs



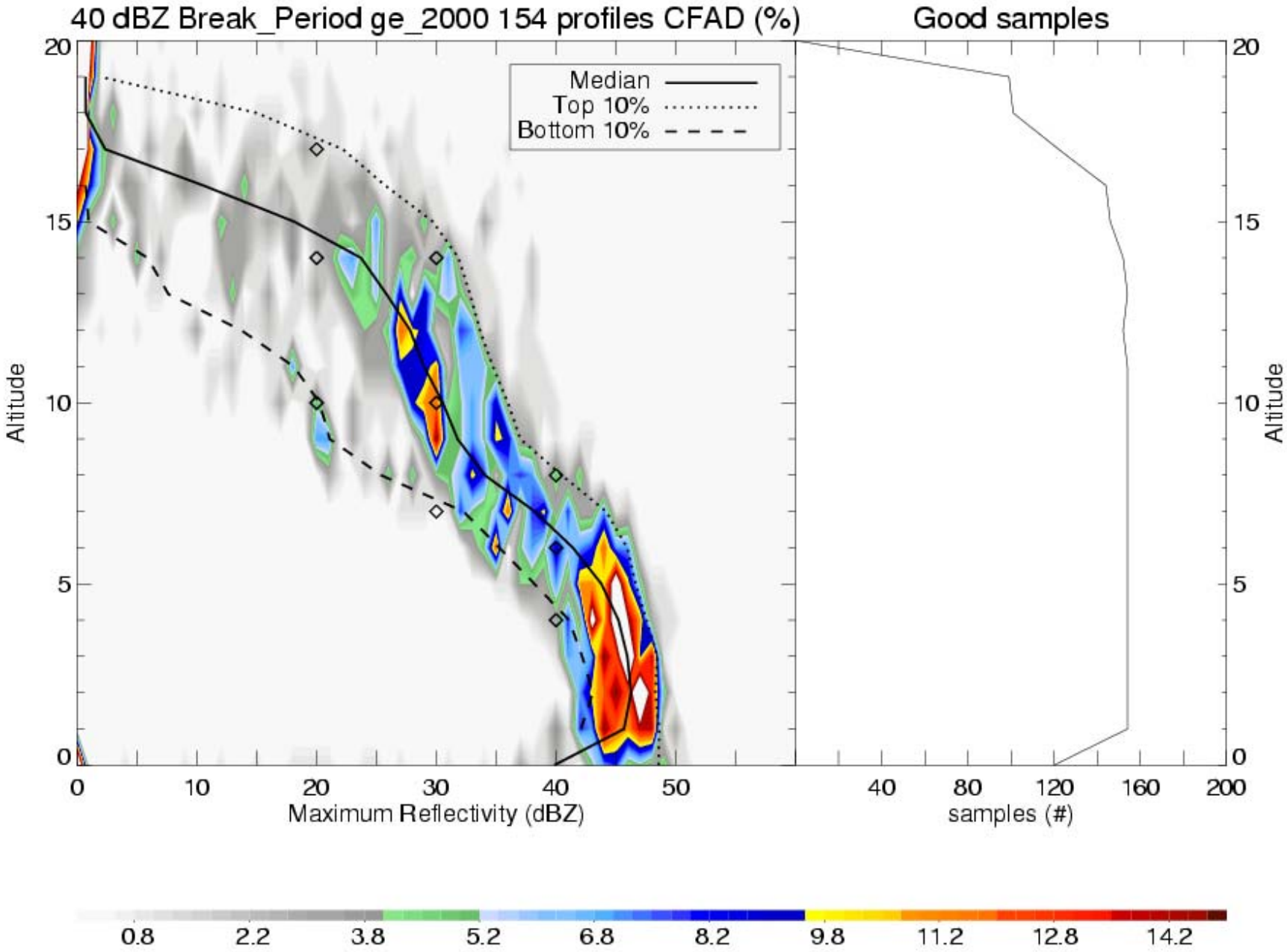
TRMM, 9 years, MCSs during “break”, ocean



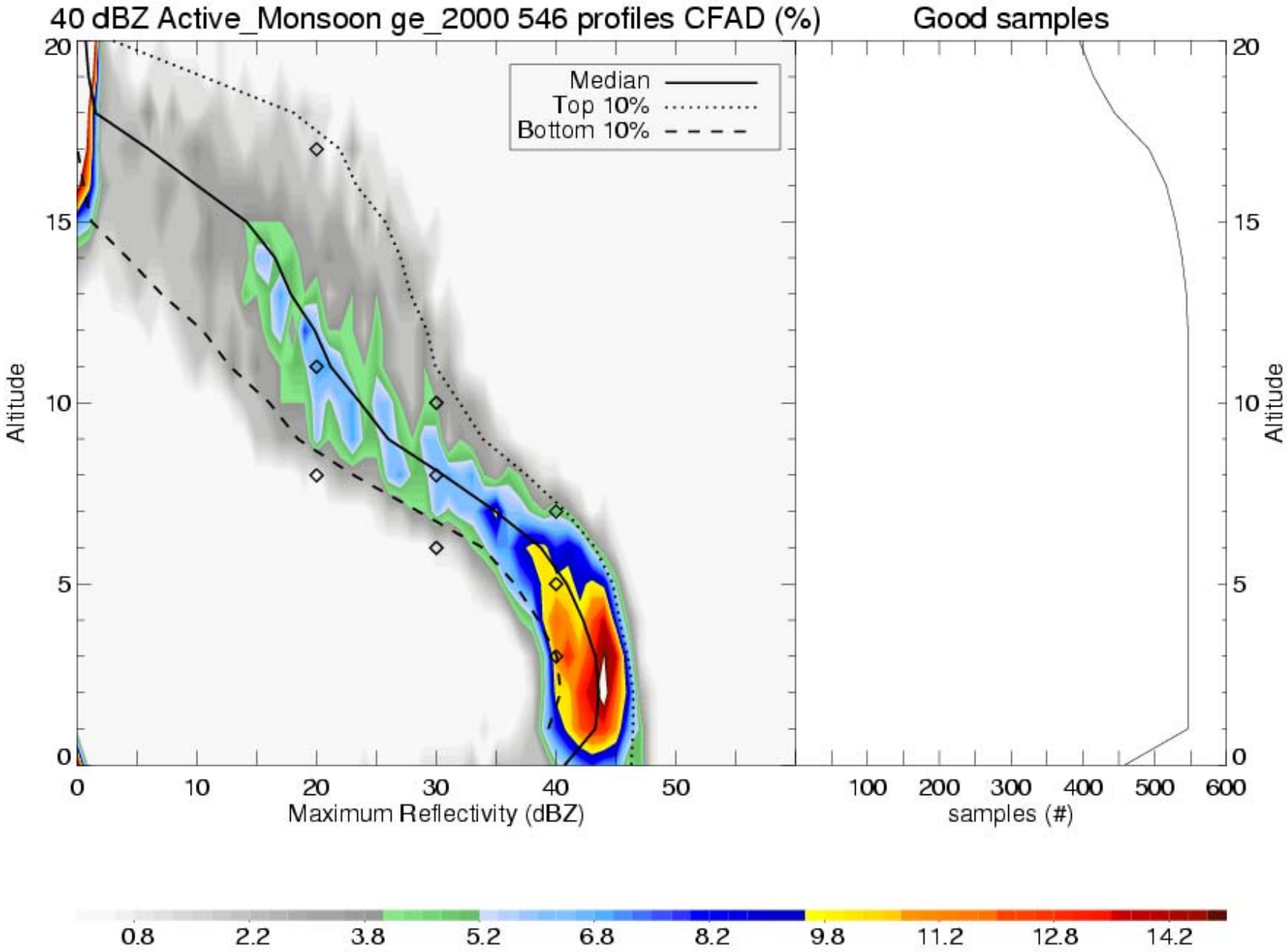
TRMM, 9 years, MCSs during “break”, land



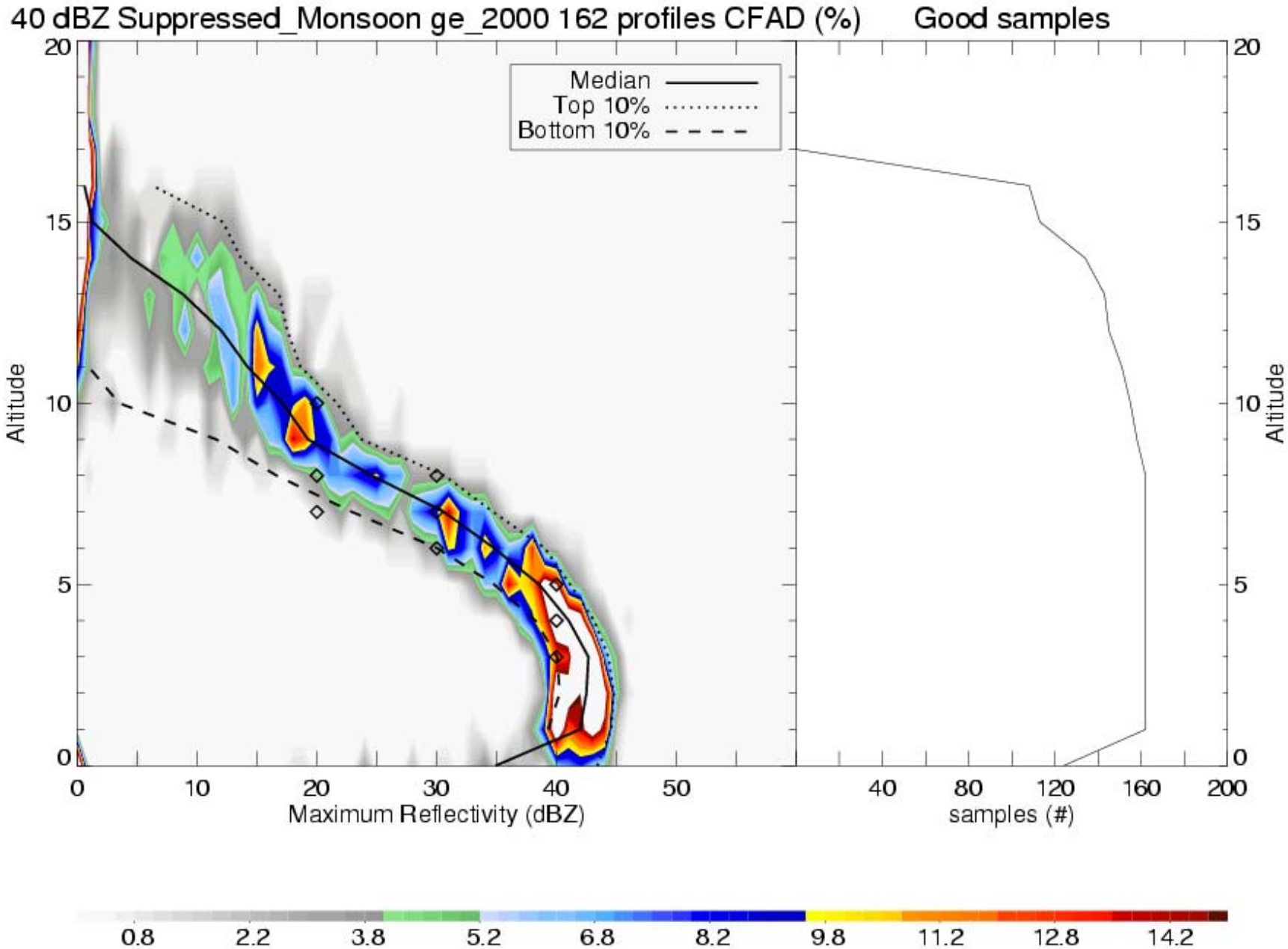
C-POL during TWP-ICE, Break, MCSs



C-POL during TWP-ICE, Active Monsoon, MCSs



C-POL during TWP-ICE, Dry Monsoon, MCSs

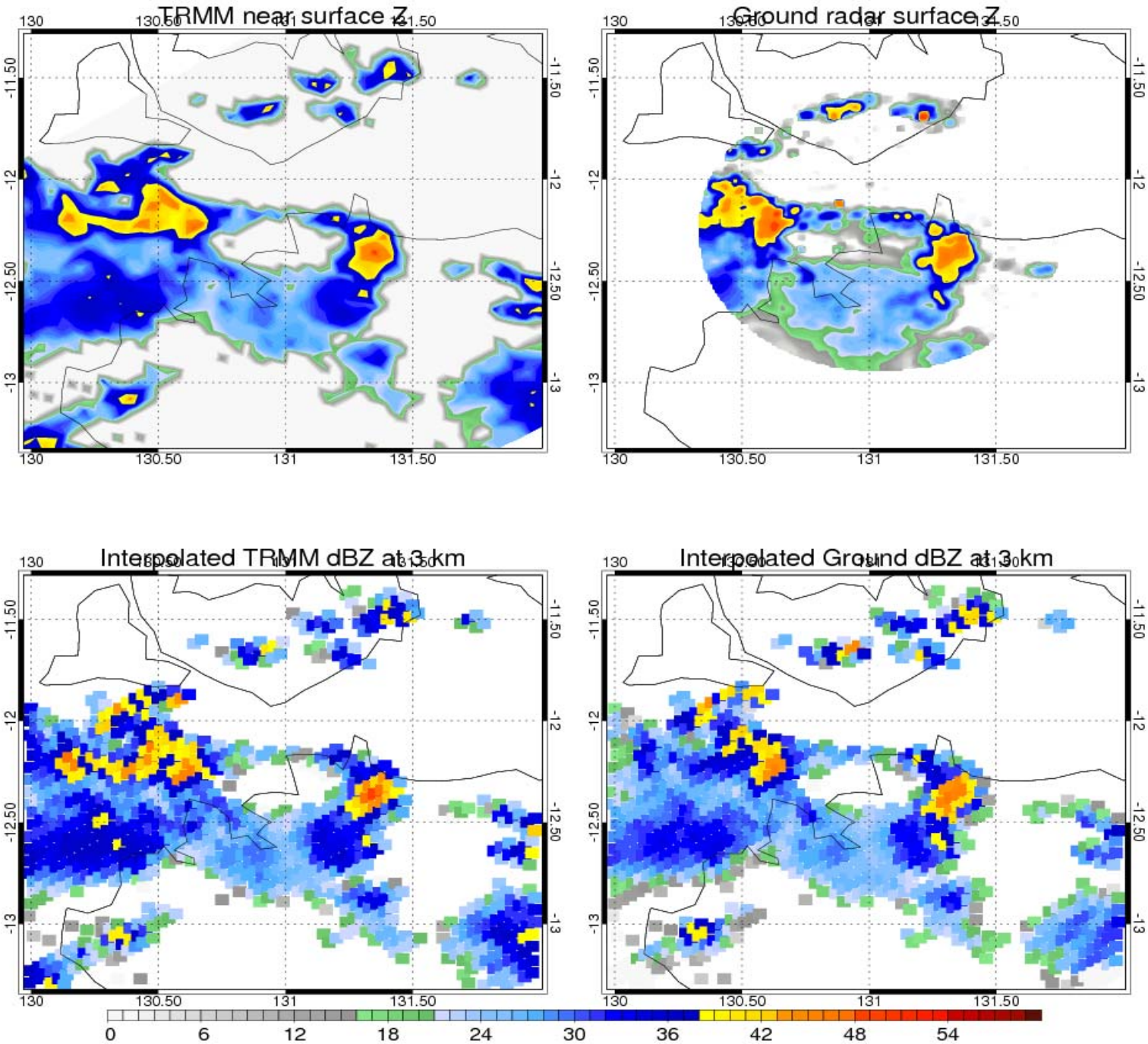


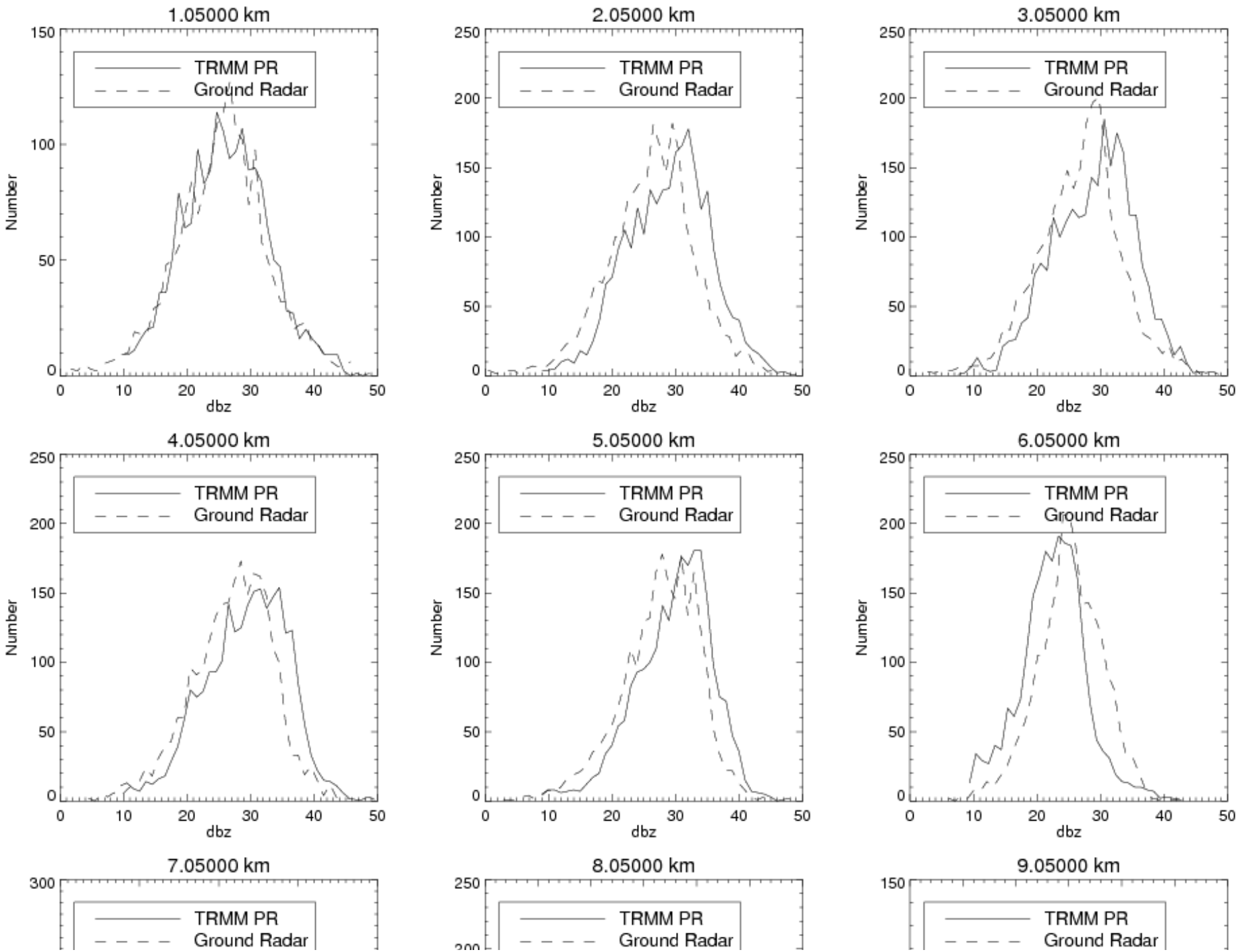
Initial Impressions

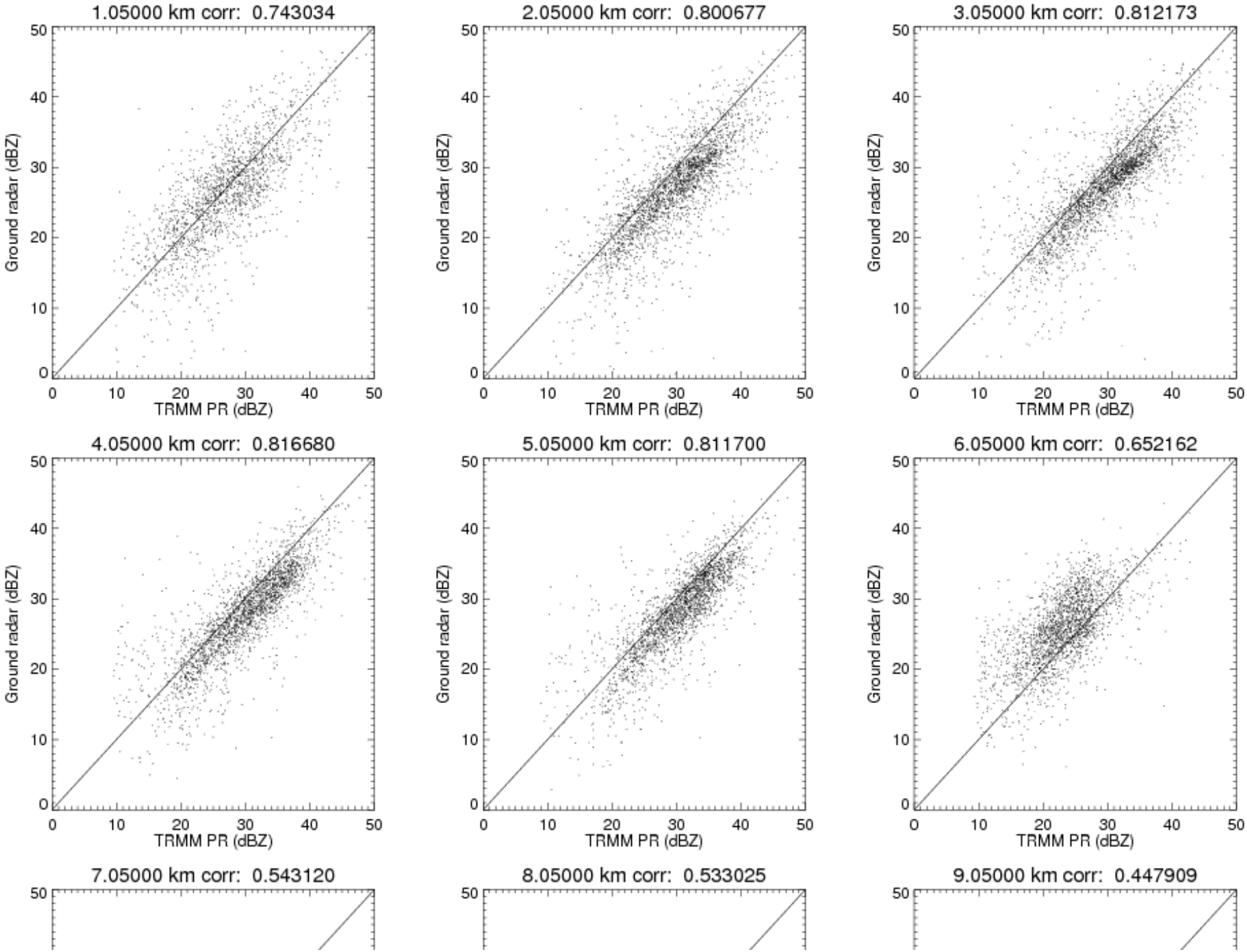
- C-POL easily captures significant differences between convective properties in the different regimes during TWP-ICE
- The active monsoon period (20-25 January 2006) had quite intense convection, perhaps near the high end of “monsoon climatology”
- C-POL has a 1.6-degree beam, so vertical structure beyond ~ 60-80 km range needs more careful analysis….especially at extreme heights

“Calibrating” C-POL vs. TRMM

- We use 9 TRMM overpasses with large area overlap between TRMM radar and C-POL during TWP-ICE
- Peter May recommends subtracting 4 dB from C-POL reflectivity; this works well for near-surface rainfall
- There are some unresolved issues at altitudes >5 km; vertical resolution differences are the likely reason


TRMM near surface Z
Ground radar surface Z
Interpolated TRMM dBZ at 3 km
Interpolated Ground dBZ at 3 km
130
130.50
131
131.50
-11.50
-12
-12.50
-13
0
6
12
18
24
30
36
42
48
54


1.05000 km
2.05000 km
3.05000 km
4.05000 km
5.05000 km
6.05000 km
7.05000 km
8.05000 km
9.05000 km
TRMM PR
Ground Radar
Number
dbz


1.05000 km corr: 0.743034
2.05000 km corr: 0.800677
3.05000 km corr: 0.812173
4.05000 km corr: 0.816680
5.05000 km corr: 0.811700
6.05000 km corr: 0.652162
7.05000 km corr: 0.543120
8.05000 km corr: 0.533025
9.05000 km corr: 0.447909
Ground radar (dBZ)
TRMM PR (dBZ)
0
10
20
30
40
50

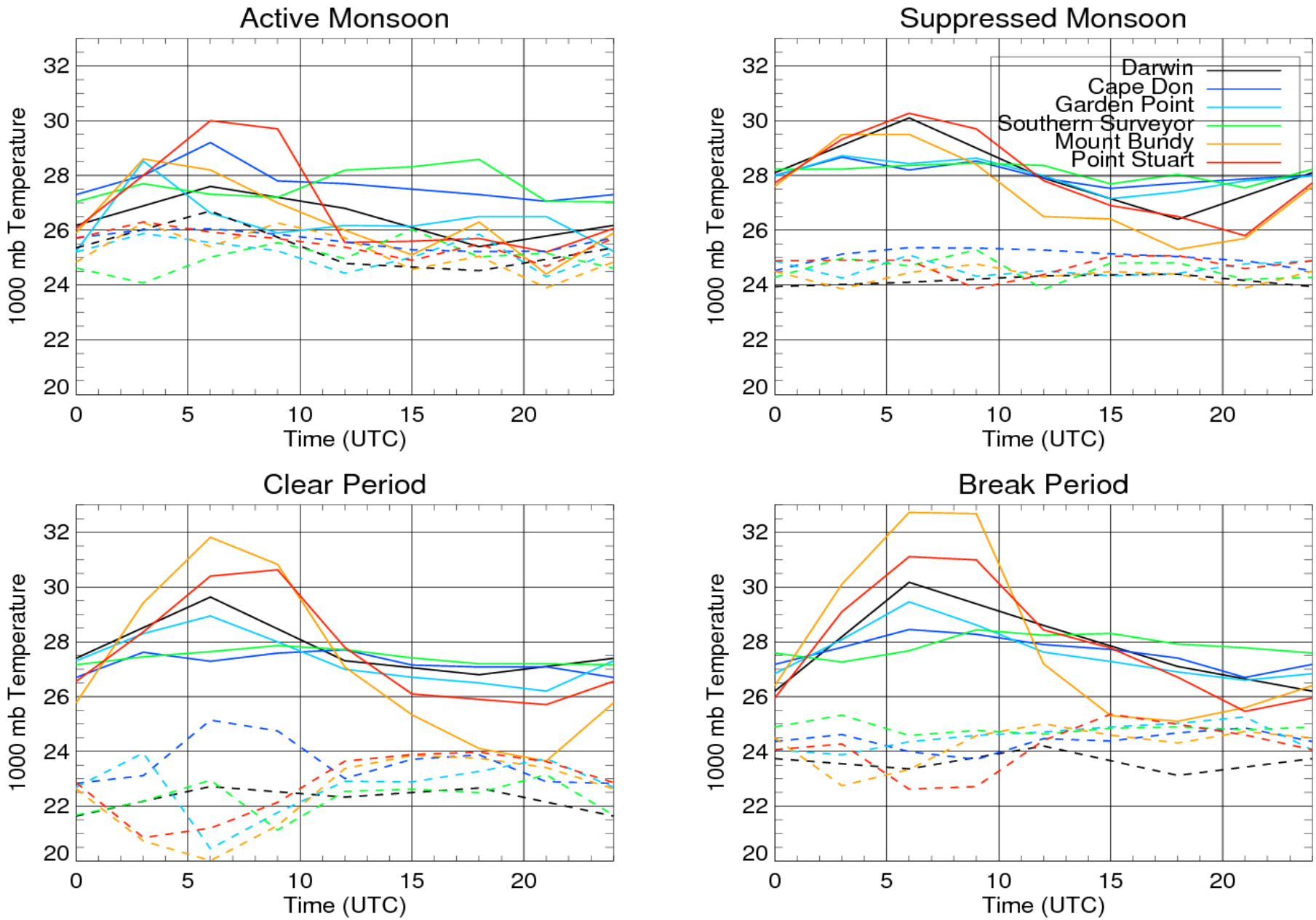
Diurnal Cycle of Temperature and Dew Point at 1000 hPa

- The diurnal cycle at TWP-ICE sounding sites shows significant gradients between land and ocean, and major differences between regimes at all sites
- NCEP reanalysis is compared with data at 3 grid points: Darwin (closest point), nearest ocean grid point, and nearest land grid point.

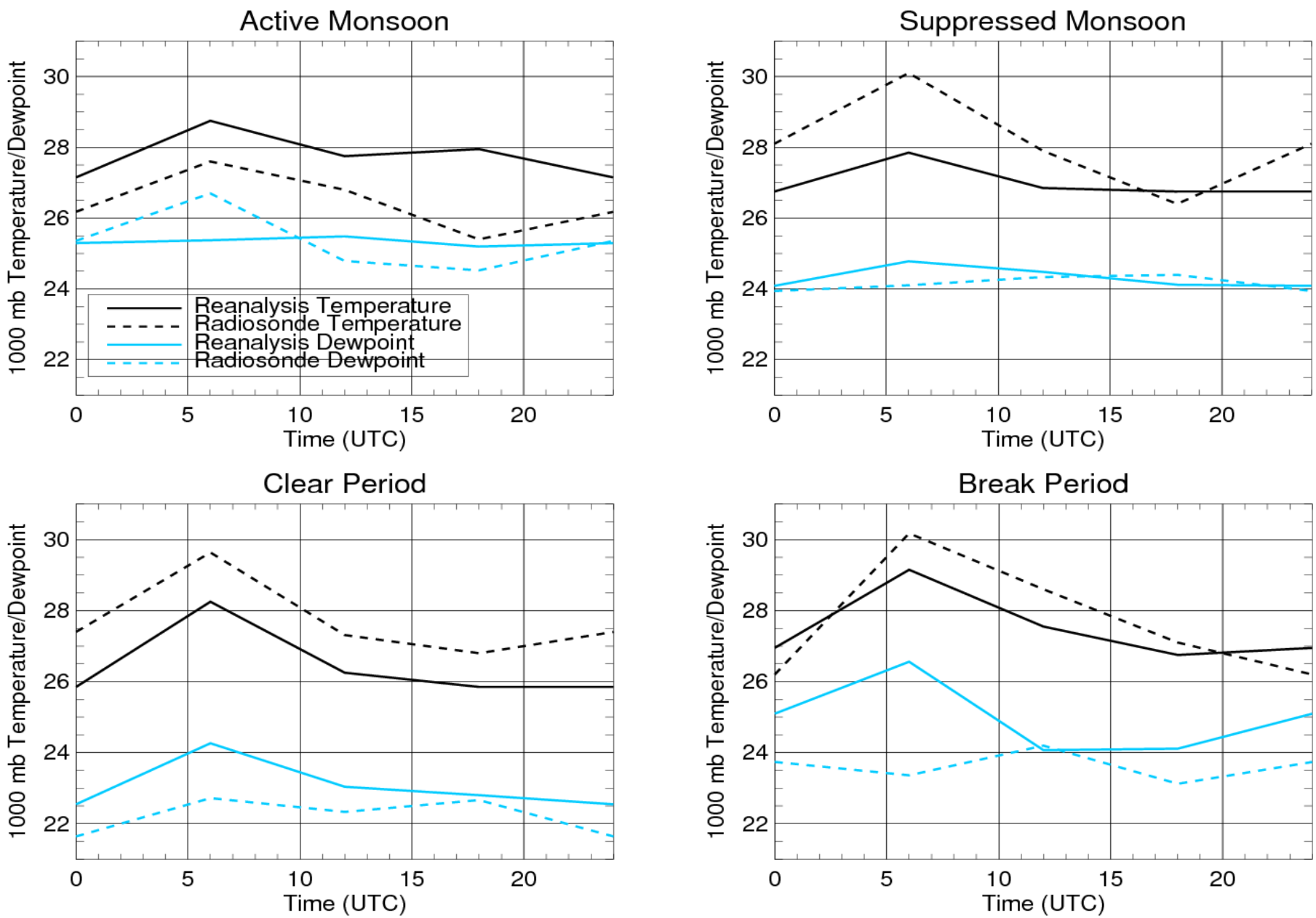
  Conclusion: reanalysis is nearly clueless.

  Question: Should we use reanalysis as the basis for cluster analysis of meteorological regimes?

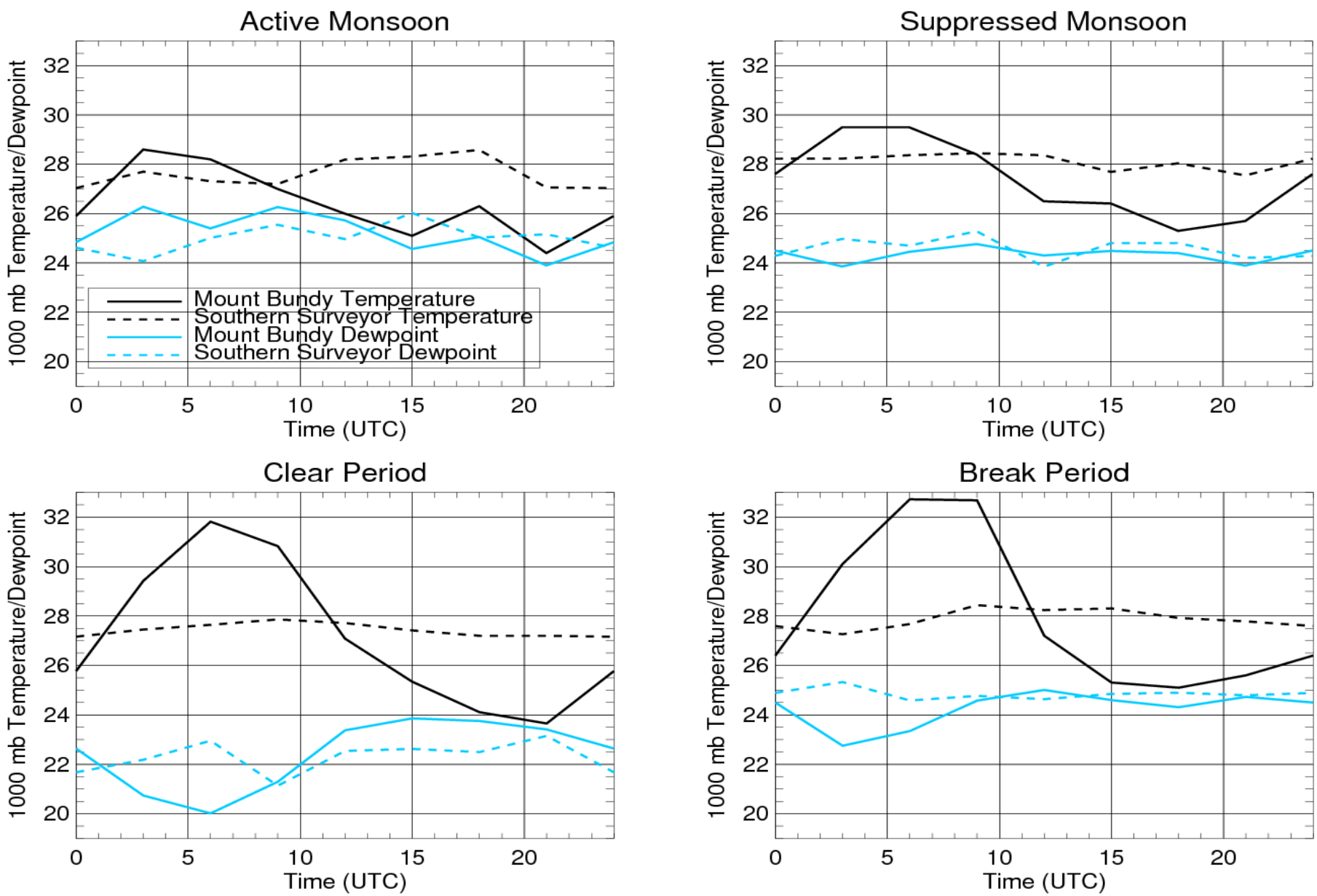
Diurnal cycle, all TWP-ICE sounding sites, 3-hrly, by regime



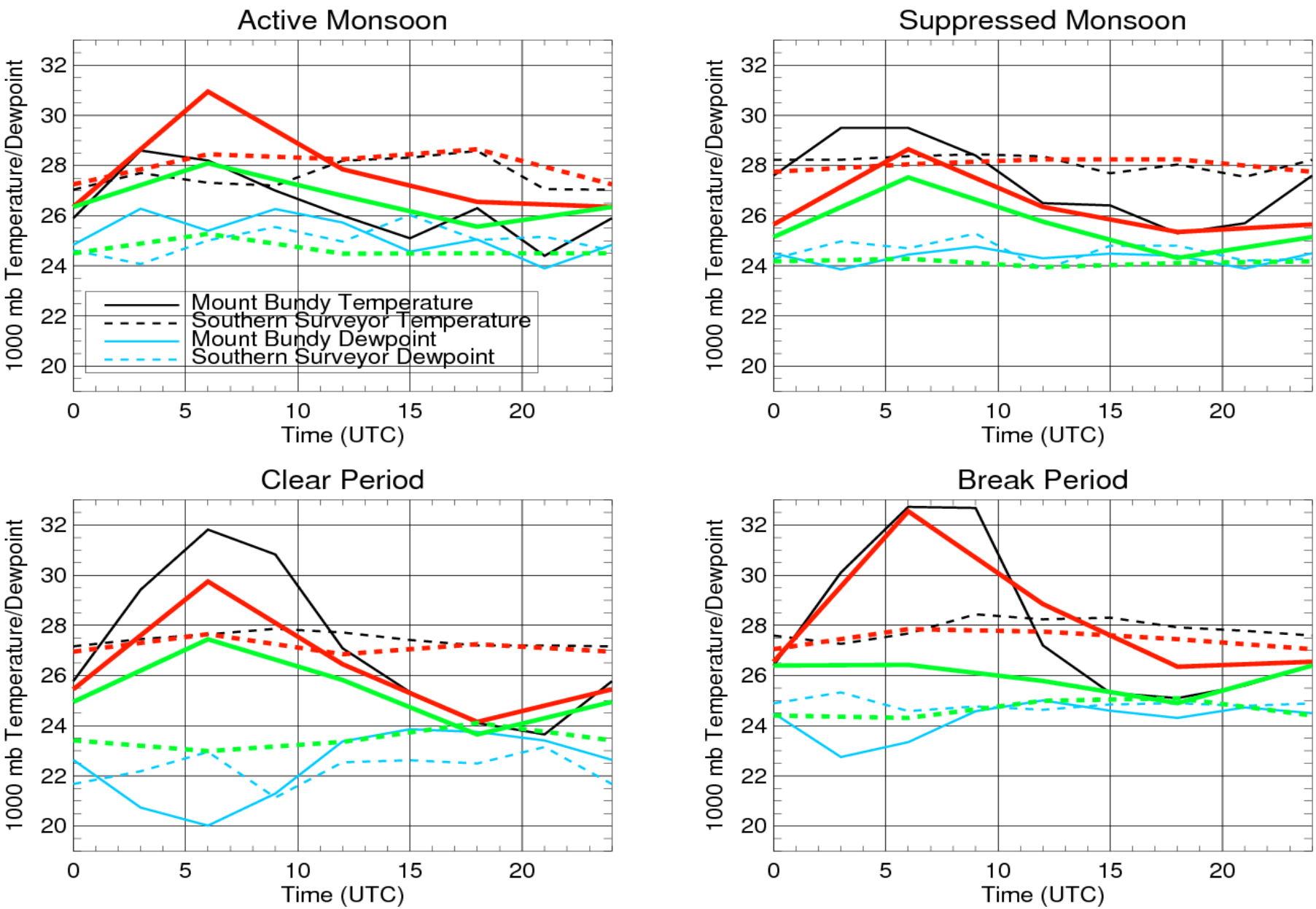
Darwin diurnal cycle *vs.* nearest NCEP grid point by regime

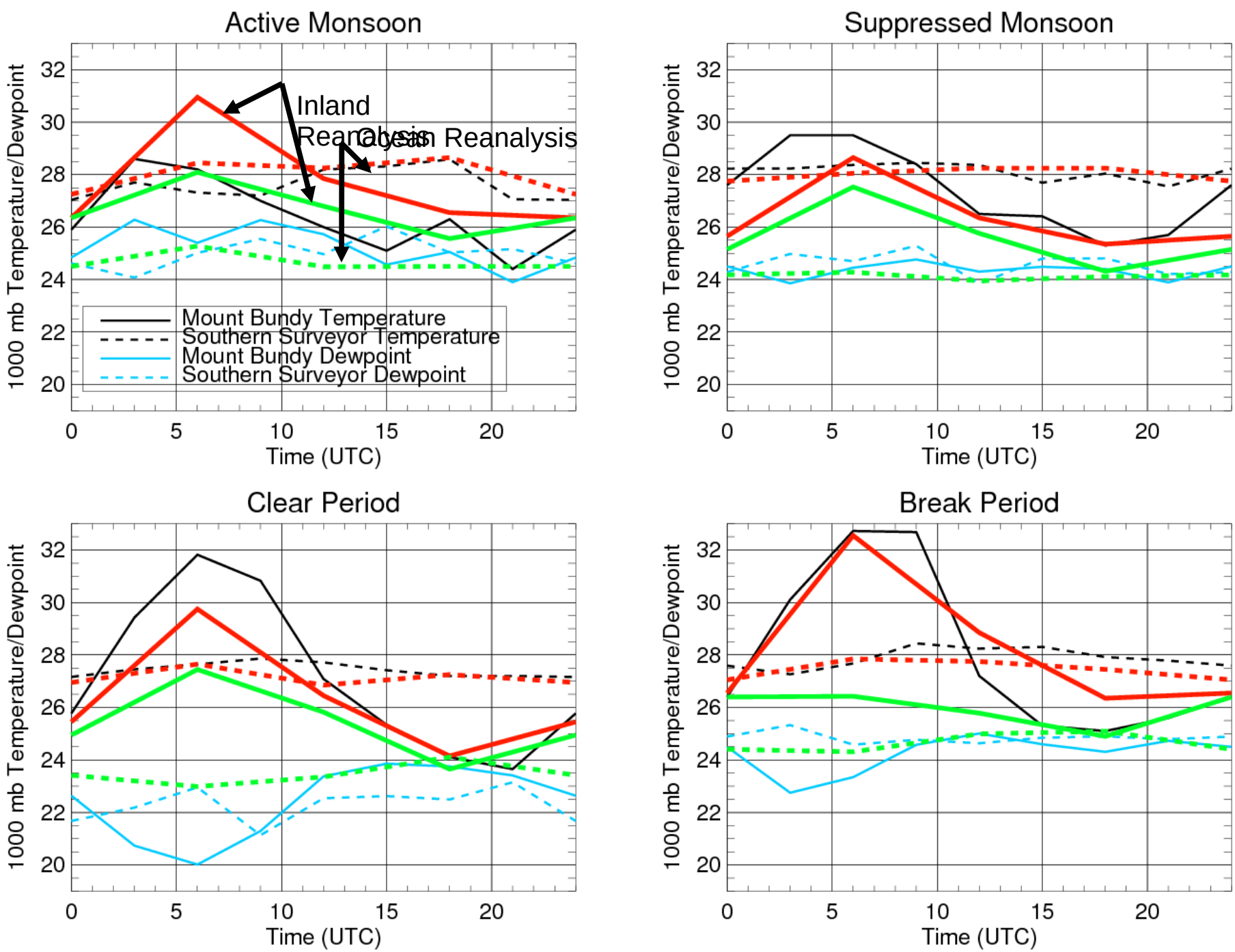


Observed contrast between ocean and inland sites (Ship and Mt. Bundy)



Actual ocean/land contrast vs. NCEP's ocean/land contrast




Active Monsoon
Suppressed Monsoon
Clear Period
Break Period
1000 mb Temperature/Dewpoint
Time (UTC)
Inland
Reanalysis
Ocean Reanalysis
Mount Bundy Temperature
Southern Surveyor Temperature
Mount Bundy Dewpoint
Southern Surveyor Dewpoint

THANK YOU!